

## CLAIMS

1. A variable attenuator comprising:

a first signal input terminal;

a first signal output terminal;

5 a first control terminal receiving a control voltage;

an analog/digital converter converting the control voltage to M (M is a positive integer of 2 or more) control signals; and

10 N ( N is a positive integer satisfying  $N \geq M$ ) variable impedance elements which are connected in parallel and/or in series between the first signal input terminal and the first signal output terminal, each impedance of which being varied by either one of the control signals.

15 2. The variable attenuator according to claim 1, wherein the N variable impedance elements have the same configuration and are connected in parallel between the first signal input terminal and the first signal output terminal.

20 3. The variable attenuator according to claim 1, wherein the control signals are binary digital signals having a first value and a second value, and the analog/digital converter outputs K (K is an integer satisfying  $0 \leq K \leq M$ ) control signals having the first value and (M-K) control

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signals having the second value, a number of K being almost in proportion to a level of the control voltage, and

N and M are the same value, and the N variable impedance elements have the same configuration and are  
5 connected in parallel between the first signal input terminal and the first signal output terminal and switched to have either one of two impedance values by the respective control signals.

10 4. The variable attenuator according to claim 3, wherein the variable impedance element comprises:  
a second signal input terminal;  
a second signal output terminal;  
a second control terminal receiving a control signal;  
15 a constant voltage terminal;  
a series connector having two resistors which are connected in series and have almost the same impedance, and being inserted between the second signal input terminal and the second signal output terminal; and  
20 a switching element which is inserted between a connecting point of the two resistors and the constant voltage terminal and is turned on or off by the control signal.

25 5. The variable attenuator according to claim 1, wherein

the variable impedance element comprises:

a second signal input terminal;

a second signal output terminal;

a second control terminal receiving a control signal;

5 a constant voltage terminal;

a series connector having first and second passive elements connected in series, and being inserted between the second signal input terminal and the second signal output terminal ; and

10 a first MOS transistor which has a drain connected to a connecting point between the first and second passive elements, a source connected to the constant voltage terminal directly or through a resistor, and a gate receiving the control signal.

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6. The variable attenuator according to claim 5, wherein the first and second passive elements are resistors.

7. The variable attenuator according to claim 1, further comprising a third signal input terminal and a third signal output terminal, wherein

20 each variable impedance element further comprises a second circuit which is the same circuit as a first circuit connected between the first signal input terminal and the first signal output terminal in parallel or in series, and

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impedance of which is varied by the same control signal,  
and

the second circuits of the N variable impedance  
elements are connected in parallel or in series between the  
5 third signal input terminal and the third signal output  
terminal.

8. The variable attenuator according to claim 7, wherein  
the variable impedance element comprises:

- 10 a second signal input terminal;  
a second signal output terminal;  
a fourth signal input terminal;  
a fourth signal output terminal;  
a second control terminal receiving the control  
15 signal;  
a constant voltage terminal;  
a first series connector having first and second  
passive elements which are connected in series and inserted  
between the second signal input terminal and the second  
20 signal output terminal;  
a second series connector having third and fourth  
passive elements which are connected in series and inserted  
between the fourth signal input terminal and the fourth  
signal output terminal;  
25 a first MOS transistor which has a drain connected to

a connecting point between the first and second passive elements, a source connected to the constant voltage terminal directly or through a fifth passive element and a gate receiving the control signal; and

5           a second MOS transistor which has a drain connected to a connecting point between the third and fourth passive elements, a source connected to the constant voltage terminal directly or through the fifth passive element, or through a sixth passive element having the same impedance  
10       as that of the fifth passive element and a gate receiving the control signal.

9.   The variable attenuator according to claim 8, wherein the first, second, third, and fourth passive elements are  
15       resistors, or those passive element and the fifth passive element are resistors, or those passive elements and the fifth and sixth passive elements are resistors.